REMARKS

Previously pending claims 19– 36 and 91–110 were finally rejected based as being obvious, primarily upon a combination of US Patent 5,031,983 (DILLON) in view of US Patent 6,078,704 (BISCHEL). Reconsideration is respectfully requested.

The rejection's characterization of DILLON as modulator is respectfully submitted to be plain error. The rejection's statement of "Examiner's responses to Applicant's ONLY arguments are as follows" section on page 21 of the FINAL Rejection states numerous times: "It is respectfully pointed out that the device of Dillon was made invariant by Dillon for a specific application wherein invariance was desired." Hence the rejection acknowledges that DILLON does not teach a modulator. Reconsideration of the characterization of DILLON as a "modulator" is respectfully requested.

The undersigned would also like to point out that DILLON teaches that the desired angle of rotation is not achieved using the magnetic field. DILLON teaches that the magnetic field is constant and that the desired rotation is achieved by appropriate construction of the waveguide, particularly the length of the waveguide. See, e.g., col. 6, lines 21 – 28. (Note that F is the Faraday rotation per unit length and B is dependent upon the frequency.) Thus a person relying on DILLON alone would not imagine that variability is desirable or achievable as varying a length of the waveguide for variable rotation angles would likely not be feasible.

A discussion of the magnetic field requirement of DILLON is at col. 7, lines 34–38 and is required to magnetically saturate the waveguide. The inclusion of the discussion of an electromagnetic coil seems to be taken by the rejection as sufficient grounds to suggest variability of the magnetic field. However, as noted throughout, such variability destroys the isolation function of DILLON and does not teach, suggest, or reasonably motivate variable magnetic field. In fact, beyond magnetic saturation, the only magnetic field requirement actually taught by DILLON is that the magnetic field be CONSTANT.

Consequently, the argument advanced by the rejection for combination of DILLON and BISCHEL is weakened when DILLON is properly considered to be something other than a modulator:

The rejection cites BISCHCEL as evidence that workers of ordinary skill in the art would the reason, suggestion, or motivation to add the use of integrated electro-optical modulators (of most any type, including electromagnetic) in a display method ... to provide a high brightness, energy efficient, flat panel pixel display." It is respectfully submitted that this evidence be reconsidered for a number of reasons:

- DILLON does not teach modulation, hence a teaching of BISCHEL with respect to what may or may not be evidence for use of integrated electro-optical modulators is respectfully asserted to be irrelevant to DILLON.

- BISCHEL teaches extraction of radiation from a waveguide through the bounding layer transverse to the propagation axis of the propagating waveguide using electro-optic principles. The rejection's characterization of some equality of electro-magnetic principles and electro-optical principles is respectfully requested to be reconsidered. The undersigned respectfully requests that the Examiner cite some teaching explaining this equivalence or correspondence to better enable a response to this assertion. For example, BISCHEL operates by altering indices of refraction and DILLON operates using the Faraday effect for changing polarization along the propagation axis. It is not completely clear to the undersigned what the BISCHEL reference is asserted to add to DILLON. If is simply that one can arrange modulators into a display grid, then the entire argument seems to require that DILLON teach a modulator which as explained above, is not the case as acknowledged by the rejection itself.

- Even assuming *arguendo* that DILLON taught a modulator (electro-magnetic), BISCHEL would not be sufficient teaching or motivation as asserted because the arrangement and control of an electro-optical system that extracts a signal transverse to the waveguide propagation axis and that operates using modifications to the index of refraction of the structure(s) of the waveguide are not applicable to modulation based upon polarization angle control as recited in the claims (e.g., electromagnetic effects such as by use of the Faraday effect).

The rejection is respectfully asserted to fail to explain specifics of a person of ordinary skill in the art making a structure similar in some aspects to the device actually taught by DILLON but with variable radiation transmission. There may be many ways to achieve such a variability should it be desired and it is difficult for the Applicant to speculate on those details, particularly in the context of responding to a rejection based upon a reference that does not in fact teach variability. The rejection appears to rely on the teaching of the present invention in suggesting that all one would have to do is vary the magnetic field (which is taught by the specification as originally filed but not explained in the rejection as supported by any of the cited references).

<u>Specific responses to the Rejection's counter-arguments:</u>

1) DILLON teaches an invariant device: Acknowledged by the rejection. As noted above, DILLON teaches that the desired rotation angle is achieved by selecting the correct length of the waveguide and not by changing the magnetic field.

2) DILLON uses a constant magnetic field: Acknowledged by the rejection. As noted above, DILLON teaches that the desired rotation angle is achieved by selecting the correct length of the waveguide and not by changing the magnetic field.

3) Adding variance to DILLON causes it to no longer function as an isolator: The rejection asserts that adding the teaching of BISCHEL to DILLON would make DILLON a variable attenuator. As noted above, the undersigned respectfully asserts that this is a mischaracterization of the references and requests reconsideration. BISCHEL uses electro-optic manipulation of an index of refraction to extract a signal transverse to a waveguide structure while DILLON teaches a constant polarization angle shift parallel to the propagation axis using electro-magnetic fields. The applicability of one to the other is not sufficiently explained. The new references to Kumayasu and Iwaki, while stated to not be relied upon in rejecting claims 19–36 but provided to show that a combination of BISCHEL and DIILLON would be obvious, is respectfully asserted to actually be a new grounds of rejection. Kumayasu and Iwaki do not explain why BISCHEL and DILLON could be combined – the referenced section of Kumayasu may suggest variable modulation and Iwaki says something about magneto-optic displays. The fundamental problem explained above about combining BISCHEL and DILLON is not addressed by the references relied upon for the rejection. Should the rejection want to rely on these new references, the undersigned respectfully requests that the Finality of the present rejection be withdrawn and a proper rejection made so that the applicant may be aware of the rejection and have an opportunity to properly respond thereto. The rejection appears to be trying to improperly supply a missing element from the original rejection using the asserted evidence of Kumayasu and Iwaki. The fundamental assertion that modification of DILLON as suggested would make it non-functional as an isolator is not refuted.

4) Not teach a wave component varied responsive to a control signal: Again, invariance of DILLON is acknowledged by the rejection – the rejection simply says that DILLON chooses invariance yet no references relied on in the

rejection support variation of DILLON. The rejection asserts that "... variability suitable for an optical display is taught, with proper motivation to combine, by secondary reference, Bischel." This acknowledges non-variability by DILLON and the undersigned has requested consideration of the asserted propriety of the motivation of BISCHEL to modify DILLON. As noted above, DILLON teaches that the desired rotation angle is achieved by selecting the correct length of the waveguide and not by changing the magnetic field.

5) DILLON does not teach visible light: the rejection "points out" that "one of ordinary skill in the art would know that such a method is not at all limited to optical applications other than visible light. Variability of visible light suitable for an optical display is taught, with proper motivation to combine, by secondary reference, Bischel." The rejection fails to support this assertion and reconsideration is requested. It is the case that Faraday rotation is strongly dependent upon frequency and Verdet constant which is a property of the material. Absorption of light, particularly visible light and most especially blue light, is extremely high in many materials having a high enough Verdet value. Implicit in creating a "display" is generating sufficient brightness and contrast among the different elements. Brightness is a function of the absorption/transmission of the material at the desired wavelength and contrast is achieved based upon a degree of radiation amplitude modulation options for the collection of pixel elements with the specified brightness. The specification teaches that this is preferably achieved when having a capacity of a full ninety degrees of rotation (for fully on and fully off). The rejection seems to suggest that any variability is sufficient for a display but for a display method it is actually required to have enough contrast for the elements to be discernable. Which means that it is not simply a matter of choosing a different (i.e., visible) frequency other than

the non-visible radiation taught by DILLON. Other frequencies affect both the transmission and the contrast. Additionally, DILLON teaches that use of a different frequency (within a limited useful operating range, while possible, requires rotation of the output polarizer. (See, e.g., Col. 8, lines 30–37).

6) It is not possible to combine BISCHEL to DILLON: "... the device of Dillon would be functional as a variable attenuator of visible light in a display as modified by the teachings of Bischel. This is well known in the art, ... (Kumayasu) ... and ... (Iwaki).... Please note that both Kumayasu and Iwaki are not applied to reject claims 19–36; however they do show that the combination of Bishecl to Dillon would have been obvious to one of ordinary skill in the art." As noted above, BISCHEL teaches an electro-optical system that manipulates indices of refraction of a waveguide to "tap" TRANSVERSLY through the bounding/cladding regions of the waveguide a radiation signal propagating along a propagation axis of the waveguide. DILLON teaches a magneto-optic isolator that invariably rotates a polarization angle of an input radiation signal by about 45 degrees at an exit aperture (collinear with a propagation axis of a waveguide supporting input radiation signal) of the waveguide propagating the input radiation signal. DILLON fails to teach, suggest, or motivate modulation. The modulation methods of BISCHEL are inapplicable to DILLON, should there be any motivation to combine. Neither BISCHEL, or the rejection, discusses conversion of an electro-optical isolator (should there be such a device) into an electro-optical modulator or discusses/explains how an electro-optical modulation principles that vary indices of refraction to transversely extract a portion of signal from a waveguide may be applicable to a magneto-optic device using variable magnetic control (which is also not taught by the expressly cited references) of a polarization angle to achieve output modulation.

7) Lasers can cause eye damage: The rejection simply states – "... the device of DILLON would be functional as a variable attenuator of visible light in a display without causing eye damage as modified by the teachings of Bischel. This is well known in the art, ... (Kumayasu) ... and ... (Iwaki).... Please note that both Kumayasu and Iwaki are not applied to reject claims 19–36; however they do show that the combination of Bischel to Dillon would have been obvious to one of ordinary skill in the art." Reference is made to the discussion of point 5) above. While BISCHEL teaches use of semiconductor diode laser at visible wavelengths, the discussion above about absorption is particularly applicable to semiconductor lasers as light sources for visible magneto-optic switching. Semiconductor diode lasers generally do not have sufficient amplitude to function as a display unless configured into a more powerful device, e.g., a VCSEL array (vertical cavity surface emitting laser) to overcome absorption losses. It is these more powerful lasers which may provide sufficient amplitude which in turn may cause laser eye damage. It is respectfully submitted that light sources of BISCHEL are likely insufficient to motivate a person of ordinary skill in the art familiar with absorption of visible light by high verdet magneto-optic materials to combine the teachings as suggested.

8) Dependent claims are allowable because they directly or indirectly depend from an allowable base claim: "... in so far as Applicant has not argued rejection(s) of the limitations of the dependent claim(s), Applicant has acquiesced said rejection(s)." The Applicant has not acquiesced to the rejections of the claims dependent from claim 19. The Applicant was attempting to expedite prosecution by pointing out what is respectfully asserted to be a significant mischaracterization of DILLON, namely the rejection's assertion that DILLON could be said to teach, suggest or motivation any type of modulation as originally asserted. It is respectfully

asserted that that position is borne out by the current rejection of essentially similar claims 91–110 that now include Kumayasu and Iwaki (the references now referenced but "not relied upon" for the rejection of 19–36. However, as the rejection fails to acknowledge this situation, the following are specifics regarding the dependent claims:

a. Claim 21: "elements are integrated into said transport" - the polarization features in DILLON are taught as being provided by the input and output optical fibers connecting to an input and output of the isolator (see, e.g., col. 7, lines 16–26). This not integration as disclosed and claimed. Reconsideration is respectfully requested.

b. Claim 22: "... producing a controllable magnetic field parallel to a propagation direction of said wave through said transport to alter said polarization property" – DILLON does not teach varying a magnetic field and BISCHEL does not alter polarization angles of propagating radiation. Reconsideration is respectfully requested.

c. Claim 23: "...altering said polarization property by changing a rotation angle of said wave component in a range from about zero degrees to about ninety degrees" – DILLON does not teach varying a magnetic field by any amount, much less by 90 degrees and BISCHEL does not alter polarization angles of propagating radiation. Reconsideration is respectfully requested.

d. Claim 24: "...said transport is a fiber waveguide including a core and a cladding and wherein said influencer includes a magnetic material proximate said cladding" – DILLON teaches that the isolator may be a waveguide but it is a discrete non-fiber structure that is inserted between two fibers. Reconsideration is respectfully requested.

e. Claim 26: " ... selectively magnetizing said magnetic material responsive to an electric current" – DILLON does not teach selective magnetization, while there is a magnetic coil it is taught that the magnetization is, and must be, constant. Reconsideration is respectfully requested.

f. Claim 27: " ... said magnetic material is integrated into said fiber waveguide" – there is no discussion of integration. The cited portions of DILLON simply support that the isolator is a stand-alone device. There is no mention of integration of the magnetic material of the influencer being integrated. Reconsideration is respectfully requested.

g. Claims 34–36: Claim 34 recites an additional element, a front panel. Claim 35 recites a pixel effect element proximate each corresponding output port. Claim 36 recites that the pixel effect element disperses the wave component from the corresponding output port. The rejection fails to set forth how these elements are satisfied by the combination of DILLON and BISCHEL. Reconsideration is respectfully requested.

CLAIMS 91–110

Claims 91–110 were rejected as being unpatentable over DILLON in view of BISCHEL, KUMAYASU, and IWAKI. The rejection reasserts the characterizations of DILLON and BISCHEL as discussed above. These characterizations are respectfully requested to be reconsidered in light of the comments above. DILLON does not teach a modulator. Bischel does not discuss modulation based upon polarization changes. BISCHEL does not teach use of isolators as components of a display. Even if it were proper to combine DILLON and BISCHEL, the combination would not function as claimed.

The additional references of KUMAYASU and IWAKI are discussed below (relevant to all rejections).

IWAKI

IWAKI simply states that some type of magneto-optic display device, in addition to other valving systems, may be used to modulate an optical wave component. The rejection asserts: "Iwaki is evidence that workers of ordinary skill in the art would find the reason, suggestion, or motivation to any of ... magneto-optic display device as recognized equivalents for the same purpose of modulating light." The reliance that the rejection places on this reference is not understood. IWAKI does not define these terms and it is not clear what the rejection believes are recognized equivalents. An isolator may be a magneto-optic device but its applicability to being a display device is not understood. An isolator is respectfully asserted to not be a magneto-optic display device consistent with the meaning of the term within the claims 91–110. Not until the rejection explains how an isolator may function as a display device would the citation to IWAKI seem to be appropriate. Certainly not all magneto-optic components and devices are asserted be display devices or capable, on their own, of modulating an optical wave component. The language of IWAKI is respectfully asserted to not support such a conclusion.

KUMAYASU

The rejection asserts: "Kumayasu teaches that a magneto-optic isolator teaches structure that obviously be used as a variable magneto-optical attenuator with addition of a simple magnetic coil to provide magnetic field strength responsive to an electric signal (current) ... to comprise a satisfactory variable magneto-optical attenuator. Kumayasu is evidence that workers of ordinary skill in the art would find the reason, suggestion, or motivation to add the electrical signal controlled optical attenuating display device of Bischel to the magneto-optic device of Dillon to comprise a satisfactory variable magneto-optical attenuator controlled display device. Therefore it would have been obvious to one

having ordinary skill in the art at the time the invention was made to modify the invention of Dillon with the teachings of Bischel to create a satisfactory display device by combining the electrical signal controlled optical attenuating display device of Bischel to the magneto-optic device of Dillon to comprise a satisfactory variable magneto-optical attenuator controlled display device."

Kumayasu, while it may provide some evidence that properly constructed and operated magneto-optic device may individually attenuate a radiation signal propagating therethrough, the conclusion of the rejection that this supports a combination of Bischel and Dillon is respectfully asserted to be incorrect and reconsideration is requested. As discussed above, Dillon teaches away from attenuation and to the extent that it discusses a polarization rotation, that is achieved by controlling a length of the waveguide.

Bischel teaches modulation using electro-optic systems that extract a signal transversely from a waveguide. The principles of operation are different (Faraday rotation for DILLON and variation of indices of refraction for BISCHEL) teach away from combining these references as the two are in completely different endeavors: DILLON in communication channel architecture and BISCHEL in display technology.

Assuming *arguendo* that combination of the two references would be proper, it is respectfully asserted that the combination would be inoperative or at a minimum fail to satisfy all the limitations of the claims. When the rejection asserts a teaching in a combination of DILLON and BISCHEL to "modify the invention of Dillon with the teachings of Bischel to create a satisfactory display device by combining the electrical signal controlled optical attenuating display device of Bischel to the magneto-optic device of Dillon to comprise a satisfactory variable magneto-optical attenuator controlled display device" it is unclear how such a device would operate. The DILLON system uses Faraday rotation control of an in-waveguide propagating signal while BISCHEL uses electro-optical manipulation of an index of refraction to selectively transversely extract a wave component from a waveguide. It is unclear what the combination is or which pieces of which element

are included in the rejection. It is respectfully asserted that the combination would not work or would not employ polarization properties. Reconsideration is respectfully requested.

Dependent claims 92–109 are asserted to be patentable for the reasons set forth in a discussion of the independent, and in addition to the arguments presented above with regard to points a. through g. in discussion of corresponding dependent claims. In addition, claim 109 recites visible light, not taught or suggested by DILLON.

ADDITIONAL COMMENTS:

Dillon is for a waveguide magneto-optic isolator NOT modulator. It can be extrapolated that a modulator can be an isolator, but not that an isolator can be a modulator. For example, a modulator with +/- 5° rotation angle can function as a good isolator, but not truly function as a modulator sufficient for a display device.

Dillon has a single rotation polarization angle and states that a variance of ± 5° from the ideal angle still may produce acceptable isolating attributes (Dillon, column 5 lines 60-65 and column 6 lines 15-20). However, this does not teach that the DILLON device variably operates over this range in any device.

Dillon does not state the range of applicable wavelengths for use of the isolator, but does mention 1.55μm wavelengths. Significant changes must be made that are not obvious to one versed in the art to allow for optimal properties at shorter wavelengths necessary for display applications as noted in the present invention as implicated in the present claims. For example, to achieve the necessary 45° rotation, one would have to use thick films (on the order of several micrometers). However, thick films absorb much of the light rendering them useless for providing the appropriate illumination for display applications. (Journal of Physics D: Applied Physics vol. 39 pg. R151 2006 and referenced therein, Handbook of Thin Film Devices Vol. 4 Magnetic Thin Film Devices Chapter 3 © by Academic Press). Therefore in consideration of Bischel, it is not obvious to one versed in

the art how the application of Bischel to Dillon will produce a 90° bandwidth modulator with the necessary optical transmission characteristics for the isolator device presented in Dillon.

Lastly, with regard to Dillon in view of Bischel and the application of electro-optical modulators of Bischel to Dillon. The physics governing the electro-optic modulator of Bischel involve changes in the index of refraction. The device is an electrically controllable stacked dielectric optical energy redirector (Bischel, column 7 lines 55-60). The light is redirected by changes in the index of refraction of the material. This differs from attenuation of light by Faraday rotation in that Faraday rotation is governed by the Verdet constant of the film and not the index of refraction. The Verdet constant is a measure of the Faraday effect, which is a magneto-optic effect and the laws governing the relationship of attenuation of light by the Faraday effect are fundamentally different from those governing the electro-optic effects produced by changes in the index of refraction. For example:

The electro-optic effect by changes in index of refraction as a function of applied electric field are governed by (Bischel, column 13 lines 25-35):

$$\delta n_e = - r_{33} E_3 n_e^3 / 2$$

Where r_{33} is the appropriate electro-optic nonlinear optical coefficient, E_3 is the applied electric field,

Whereas the magneto-optic effect (i.e., Faraday Rotation) by changes in the Verdet constant are governed by:

$$\beta = VBd$$

Where β is the angle of rotation (in radians).

B is the magnetic flux density in the direction of propagation (in teslas).

d is the length of the path (in meters) where the light and magnetic field interact.

Then V is the Verdet constant for the material. This empirical proportionality constant (in units of radians per tesla per meter, rad/(T•m)) varies with wavelength and temperature and is tabulated for various materials.

It is noted here that the relationship of the Verdet constant to the index of refraction in as follows:

$$V = -\frac{e}{2mc}\lambda\frac{dn}{d\lambda}$$

However, it can still be seen that the Faraday rotation is dependent on the interaction length between the light and the magnetic field.

Furthermore, the behavior of the Faraday rotation becomes more complex for materials such as iron garnets, where the Faraday rotation is given by:

$$\Theta_F = C(\lambda)M_c(T) + D(\lambda)M_d(T) + A(\lambda)M_a(T),$$

where C(λ), D(λ) and A(λ) are the wavelength dependent magneto-optic coefficients of the c (dodecahedral), d (tetrahedral) and a (octahedral) sublattices, respectively. (Journal of Applied Physics vol. 63 pg. 3113-5, 1988 and references therein). As can be seen from the equation, these materials are subject to temperature variations and Faraday rotation variation as a function of wavelength. In addition, absorption characteristics of the materials are one of the most important differences between Dillon in view of Bischel and using Faraday systems for visible light. The energies of charge-transfer transitions in Faraday Rotator materials play an important part in the overall transmission capabilities of the light, which is essential to providing display capabilities as outlined in the present invention. These

parameters are significantly affected by defect substitution, film deposition method, annealing, etc. and not solely by changes in the index of refraction (Journal of Applied Physics vol. 100 pg. 113511, 2006, Journal of Applied Physics vol. 69 pg. 4756, 1991, IEEE Tranactions on Magnetics vol. 40 pg. 2805, 2004 and references therein). In addition, to compensate for absorption of the light in the magneto-optic Faraday Rotator device, it is necessary to tailor the material properties such as the magnetic uniaxial anisotropy Ku, which are not relevant to the case of optical refraction by electro-optic modulation of the index of refraction. (Journal of Physics D: Applied Physics vol. 39 pg. R151 2006 and referenced therein).

As can be seen from the equations and literature analysis, the application of the principles derived from electro-optic scattering by changes in the index of refraction to the magneto-optic attenuation of light by changes is not straightforward. Application of strategies that change the index of refraction do not correlate equivalently to change in the Faraday rotation with the necessary optical transmission characteristics, and hence achieving 0 to 90° polarization changes in the light in Dillon cannot be achieved using the simple application of the strategies of Bischel.

Polarization of light in view of Bischel state that polarization of the output beam can be a single rotation angle of 45° (Bischel column 13 lines 50-60), and attenuation of the light by changes in polarization angle cannot be achieved with the electro-optic device.

Additional differences between Dillon in view of Bischel and the present invention include the fact that the switching mechanism of Bischel depends on scattering of the light beam either towards or away from the viewer. The switching mechanism of the present invention depends on the blocking of light of a specific polarization.

For claims 91, 92 and 103-110:

The rejection states that Dillon, is a modulator, but in fact significant non-obvious improvements must be made to the isolator technology for it to function as a modulator. Even in view of Bischel.

The examiner states that it would have been obvious to modify the invention of Dillon with the teachings of Iwaki (col. 4 line 61 through col. 5 line 2). The teachings of Iwaki are for manipulation of light after production of the image by the light engine. Teachings of Iwaki give no means as to how one would amend the magneto-optic isolator of Dillon to produce a satisfactory magneto-optics display capability. Literature dated back to 1992 show poor magneto-optical characteristics in the visible wavelengths, which would not allow for sufficient display brightness, contrast, resolution , frame rates, etc. The present invention improves current magneto-optical technology to provide practical and optimal magneto-optic display technology to meet current and future display standards. (Journal of Applied Physics vol. 69 pg. 4756, 1991, Handbook of Thin Film Devices Vol. 4 Magnetic Thin Film Devices Chapter 3 © by Academic Press, Journal of Applied Physics vol. 63 pg. 3113-5, 1988 and references therein, http://www.dcimovies.com/specification/index.tt2)

In view of the above remarks, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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